IFW

HDP/SB/21 based on PTO/SB/21 (08-00)

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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	09/651,849
Filing Date	August 31, 2000
First Named Inventor	Sarath KUMAR et al.
Group Art Unit	2683
Examiner Name	Stephen M. D'Agosta
Attorney Docket Number	29250-001051/US

ENCLOSURES *(check all that apply)*

- [x] Fee Transmittal Form
  - [x] Fee Attached
- [ ] Amendment
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Response to Missing Parts/ Incomplete Application
  - [ ] Response to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Assignment Papers *(for an Application)*
- [ ] Letter to the Official Draftsperson and (   ) Sheets of Formal Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert to a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s) _____
- [ ] After Allowance Communication to Group
- [ ] LETTER SUBMITTING APPEAL BRIEF AND APPEAL BRIEF (w/clean version of pending claims)
- [x] Appeal Communication to Group (*Appeal Brief in Triplicate)*
- [ ] Proprietary Information
- [ ] Status Letter
- [ ] Other Enclosure(s) *(please identify below)*:

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm *or* Individual name	Harness, Dickey & Pierce, P.L.C.	Attorney Name John E. Curtin	Reg. No. 37,602
Signature			
Date	September 22, 2004		

PTO/SB/17 (10-01)
Approved for use through 10/31/2002. OMB 0651-0032
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OIPE SEP 22 2004 PATENT & TRADEMARK OFFICE

FEE TRANSMITTAL for FY 2003

Patent fees are subject to annual revision.

Complete if Known	
Application Number	09/651,849
Filing Date	August 31, 2000
Inventor(s)	Sarath KUMAR et al.
Examiner Name	Stephen M. D'Agosta
Group Art Unit	2683
Attorney Docket No.	29250-001051/US

TOTAL AMOUNT OF PAYMENT ($) 330.00

METHOD OF PAYMENT (check one)

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 08-0750

Deposit Account Name: Harness, Dickey & Pierce, P.L.C.

☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status. See 37 CFR 1.27

2. ☒ Payment Enclosed:

☒ Check ☐ Credit card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filling fee	

SUBTOTAL (1) ($) 0

2. **EXTRA CLAIM FEES**

			Extra Claims		Fee from below		Fee Paid
Total Claims		-20 ** =		X		=	
Independent Claims		-3 ** =		X		=	
Multiple Dependent				X		=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. **ADDITIONAL FEES**

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet.	
1053	1053	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	330
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive – unavoidable	
1453	1,330	2453	665	Petition to revive – unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17 (q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR § 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid **SUBTOTAL (3)** ($)330.00

SUBMITTED BY				Complete *(if applicable)*	
Name (Print/Type)	John E. Curtin	*Registration No. Attorney/Agent)*	37,602	*Telephone*	703-668-8000
Signature				*Date*	September 22, 2004

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Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

AF

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appeal No. ____________

Appellants:	Sarath KUMAR et al.
Application No.:	09/651,849
Group No.:	2683
Filed:	August 31, 2000
Examiner:	S. M. D'Agosta
For:	AN ENHANCED METRIC FOR BIT DETECTION ON FADING CHANNELS WITH UNKNOWN STATISTICS
Attorney Docket No.:	29250-001051/US

BRIEF ON APPEAL ON BEHALF OF APPELLANT

BOX APPEAL
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

September 22, 2004

TABLE OF CONTENTS

BRIEF ON BEHALF OF APPELLANT

In support of the Notice of Appeal filed July 23, 2004, appealing the Examiner's Final Rejection mailed January 23, 2004 of each of pending claims 1-29 (now 1, 3-6, 9-11, 15-17, 21, 23, 24, 27, 28 and 30-33) of the present application which appear in the attached Appendix, Appellant hereby provides the following remarks.

I. REAL PARTY IN INTEREST

The present application is assigned to Lucent Technologies Inc., by an Assignment recorded on March 22, 2001, Reel 011670, Frame 0528.

II. RELATED APPEALS AND INTERFERENCES

The Appellant does not know of any appeals or interferences which would directly affect or which would be directly affected by, or have a bearing on, the Board's decision in this Appeal.

III. STATUS OF THE CLAIMS

Claims 1-29 (now 1, 3-6, 9-11, 15-17, 21, 23, 24, 27, 28 and 30-33) reproduced in the attached Appendix A are the claims on Appeal. Each of these claims is currently pending in the application.

IV. STATUS OF ANY AMENDMENTS FILED SUBSEQUENT TO THE FINAL REJECTION

A Request for Reconsideration ("Request") dated June 23, 2004 (copy attached as Appendix B) along with a Declaration under 37 CFR §1.132 was filed with the U.S. Patent Office in response to the Final Rejection dated January 23, 2004. Appellants have not received a further communication from the Examiner but presume this Request has been entered and considered.

V. SUMMARY OF THE INVENTION

The invention relates to a technique for generating a log-likelihood ratio (LLR) as a function of a scale factor, where the scale factor is derived from a noise variance of received pilot symbols within a wireless signal. The genius of the present invention is the realization that scale factors can be derived from the noise variance only; there is no need to rely on signal-to-noise measurements or other parameters as in conventional techniques.

In a typical wireless channel, a transmitted signal undergoes distortion due to fading and path loss in addition to additive noise and interference.

Such fading channels are characterized by rapid amplitude and phase variations and by time and/or frequency dispersion. This poses a problem in the demodulation of phase or frequency modulated signals. A channel affected by fading causes rapid phase changes thus making it very difficult to infer the phase of a received signal from modulated data symbols. Different solutions

for this problem have been used in second and third generation wireless systems. These include non-coherent detection, differential detection, pilot signal and pilot symbol assisted schemes. While each scheme provides a mechanism that either: (a) does not require knowledge of the exact phase at a receiver, or (b) infers phase information more accurately, there is an associated loss in performance. For example, non-coherent and differential modulation result in an increase in the required signal-to-noise ratio (SNR) compared to coherent schemes; pilot signal based schemes lead to a loss in power available for the information bits; and pilot symbol based schemes lead to a loss in bandwidth and power available for information bits (see specification, p. 1).

Of the above-mentioned solutions, Pilot Symbol Assisted Modulation (PSAM) has received much attention in recent years. PSAM is part of the wideband CDMA (Code Division Multiple Access) standard of the universal mobile telecommunications system (UMTS) being studied by the 3rd Generation Partnership Project (3GPP). (3GPP is a standards body comprising the European Telecommunication Standards Institution (ETSI) and several other international standards bodies.)

The basic idea behind PSAM is to periodically insert symbols known to a receiver in an information bit stream. If the pilot symbols are inserted often enough, they can be used to estimate channel fading conditions and, therefore, can be used to coherently (i.e., with knowledge of the phase rotation introduced

by the channel) demodulate information bits. Because pilot symbols are corrupted by noise, estimates of fading conditions are not exact. Hence, the information available is insufficient to determine the optimal receiver. If fading statistics (probability density function, in particular) are known, then one can derive optimal operations to be performed at the receiver to detect transmitted bits. The form of such a receiver is know in the art.

Unfortunately, when fading statistics, or fading distribution (as is typically the case) are unknown, then this type of receiver no longer provides an optimal solution (see specification, p. 2).

The present invention seeks to overcome this problem.

FIG. 1 (Exhibit 1) illustrates an existing transmitter and multipath fading model for use in a CDMA-based system such as UMTS. The representations shown in FIG. 1 are well-known and will not be described herein. It is assumed that a BPSK modulation scheme is used, wherein information bits are encoded as +1 or -1. Wireless Transmitter 110 comprises multiplexer 105, which forms, from a data signal 101 (representing a sequence of data symbols) and a control signal 102 (representing a sequence of pilot symbols and other control information, such as a ratio β (defined below)), a PSAM signal 111 for transmission. As known in the art, PSAM signal 111 is subject to fading, noise and interference. These effects are represented by model multipath fading

channel 115, which operates on PSAM signal 111 to provide a wireless signal 116 to a wireless receiver. (It should be observed that wireless transmitter 110 represents either endpoint of a wireless connection, e.g., a base station or a terminal.)

Before continuing, the following definitions will be used:

i - subscript, denoting the multipath index; wherein $1 \leq i \leq L$; where L is the number of multipaths;

E_P - the transmitted energy per pilot symbol;

E_D - the transmitted energy per data symbol;

$\sigma_{N_i}^2$ = noise variance in the received data symbols on the i^{th} multipath;

$\sigma_{Z_i}^2$ = noise variance in the filtered (or averaged) pilot symbols received on the i^{th} multipath;

$\underline{r_I}$ - a vector quantity representing the inphase data component of the data portion of the received signal;

$\underline{r_Q}$ - a vector quantity representing the quadrature data component of the data portion of the received signal;

$\underline{p_I}$ - a vector quantity representing the inphase components of the pilot symbols;

$\underline{p_Q}$ - a vector quantity representing the quadrature components of the pilot symbols;

$\underline{\hat{P}_I}$ - a vector quantity representing filtered (or averaged) inphase components of the channel estimates (obtained from received pilot symbols);

$\underline{\hat{P}_Q}$ - a vector quantity representing filtered (or averaged) quadrature components of the channel estimates (obtained from received pilot symbols);

$\underline{\sigma}_N^2$ - a vector quantity representing the noise variance in the received data symbols over the multipaths; and

$\Lambda(\underline{r}, \underline{\hat{p}})$ - the log likelihood ratio (LLR), the magnitude of which represents the confidence the receiver has in detecting a bit, the sign of which indicates whether it is more likely that the bit is +1 or -1 (after observing the channel output) (see specification pp. 3-4).

In addition, the following ratios are defined:

$$\beta = \frac{E_p}{E_D}\text{; and} \tag{1}$$

$$G_i = \frac{\sigma_{Z_i}^2}{\sigma_{N_i}^2}\text{, where, } i \text{ denotes the } i^{th} \text{ multipath.} \tag{2}$$

Finally, $\underline{G}$ is defined as

- a vector quantity representing the ratio of the noise variance in the received pilot symbols over the multipaths to the noise variance in the received data symbols over the multipaths. As used herein (and described below), G is the same for all multipaths by design.

As noted above, when the fading distribution is unknown, then an optimal procedure for bit detection does not exist. In this case, and in accordance with the invention, a sub-optimal receiver can be derived applying a known statistical technique called the Generalized Likelihood Ratio Test (GLRT). In accordance with the invention, an LLR is then derived from:

$$\Lambda(\underline{r},\underline{\hat{p}})=\sum_{i=1}^{L}\frac{\left(r_i^I\hat{p}_i^I+r_i^Q\hat{p}_i^Q\right)\frac{\sqrt{E_D}}{\sigma_{N_i}^2}\frac{\sqrt{E_P}}{\sigma_{Z_i}^2}}{\left[\frac{E_D}{\sigma_{N_i}^2}+\frac{E_P}{\sigma_{Z_i}^2}\right]}=\sum_{i=1}^{L}\frac{\left(r_i^I\hat{p}_i^I+r_i^Q\hat{p}_i^Q\right)}{\sigma_{N_i}^2}\frac{\sqrt{\beta}}{\left(\beta+G_i\right)}. \tag{3}$$

With unknown fading statistics, and in accordance with the invention, from this LLR a scaling factor can be defined for each i multipath as:

$$w_i=\frac{\sqrt{\beta}}{\sigma_{N_i}^2\left(\beta+G_i\right)}. \tag{4}$$

Equation (3) can then be represented as:

$$\Lambda(\underline{r},\underline{\hat{p}})=\sum_{i=1}^{L}\left(r_i^I\underline{\hat{p}}_i^I+r_i^Q\hat{p}_i^Q\right)w_i. \tag{5}$$

(See specification, pp. 4-5.)

In an uncoded system, the LLR is simply compared to 0 to determine if the bit is +1 or -1. In a system that employs either convolutional or Turbo

decoding, $\Lambda(\underline{r}, \underline{\hat{p}})$ is passed to the decoder. The magnitude of $\Lambda(\underline{r}, \underline{\hat{p}})$ represents the confidence the receiver has in detecting a bit, while the sign of $\Lambda(\underline{r}, \underline{\hat{p}})$ indicates whether it is more likely that a bit will be +1 or -1 (after observing the channel output). In systems (such as UMTS) where the scaling factor could differ for bits within an encoded block, ignoring the scaling would result in improper representation of the relative confidence that the receiver has in the bits. Consequently, the performance, and observed bit error rate, of Turbo decoders and soft decision convolutional decoders would be degraded. In accordance with the invention, the correct scaling factor is determined as a function of system parameters. For a UMTS-based system, β is illustratively determined based on control channel information in accordance with equation (1), and $\sigma_{N_i}^2$ can be determined in a variety of ways. (For example, $\sigma_{N_i}^2$ may be estimated from received pilot symbols using well-known variance estimation methods or, alternatively, may be inferred from an automatic gain controller (AGC) operating point.) (See specification, pp. 5-6.)

For example, consider the uplink of a UMTS based system as an illustration. On the uplink, the base station receiver (e.g., receiver 200 of FIG. 2 (Exhibit 2), described further below) has automatic gain control (AGC) circuitry (not shown) that tries to keep the total received power at the input to the RAKE receiver close to a fixed value, say P_R, which is a known system

parameter. Consequently, in this particular case, the noise variance in received data symbols, $\sigma_{N_i}^2$, can be closely approximated by:

$$\sigma_{N_i}^2 = \sigma_N^2 = 2KN_C^D P_R; \tag{6}$$

where N_C^D is the spreading factor associated with the data symbols and K is a system gain, both known parameters.

The noise variance in the filtered pilot symbols, $\sigma_{Z_i}^2$, too, can be closely approximated by:

$$\sigma_{Z_i}^2 = \sigma_Z^2 = 2gKN_C^P P_R; \tag{7}$$

where N_C^P is the spreading factor associated with the pilot symbols (a known parameter) and g is a noise suppression factor associated with a filtering/averaging operation performed on the pilot symbols. For instance, if the filtered pilot symbols are produced by simply calculating the average of N_P consecutive pilot symbols, then $g = \frac{1}{N_P}$. Note that equations (6) and (7) imply that the noise variance in data and filtered pilot symbols is independent of the multipath index *i*. As a consequence,

$$G_1 = G = \frac{gN_C^P}{N_C^D}; \tag{8}$$

so that the weighting factor, w_i, can be written as:

$$w_i = w = \frac{\sqrt{\beta}}{\sigma_N^2\left(\beta + G\right)}; \tag{9}$$

which is also independent of the multipath index, i, and the number of multipaths, L. For a given G (which depends on known system parameters and the data and pilot symbol rates, the latter via N_C^D and N_C^P, respectively), there is, and in accordance with the invention, a common weight factor for all multipaths, which is a function of the energy ratio, β, above. (This may be contrasted with the weighting factors one comes across in literature, which are typically based on the assumption that the fading distribution is known. These weighting factors additionally require the knowledge of the number of multipaths being received and the relative strength of each multipath.) (See specification, pp. 6-7.)

A portion of a wireless receiver 200 (hereafter referred to as receiver 200) in accordance with the principles of the invention is shown in FIG. 2. (It should be observed that the various forms of the wireless receivers described herein represent either endpoint of a wireless connection, e.g., a base station or a terminal.) Other than the inventive concept, the elements shown in FIG. 2 are well known and will not be described in detail. For example, controller 225 is representative of a stored-program-controlled processor with associated

memory (not shown) as known in the art. It should also be noted that only that portion of receiver 200 related to the inventive concept is shown, e.g., other processing by receiver 200 of the received signal is not described. Further, detailed descriptions of the reception and demodulation of a wireless signal are not necessary for an understanding of the inventive concept and, as such, they have been simplified herein. (For example, the received signal must also be de-interleaved.) In a wireless system, a RAKE receiver finger locks onto and demodulates one of the L multipaths. The outputs of all RAKE receiver fingers are combined and then fed to a turbo/convolutional decoder (not shown).) In the context of the inventive concept, a RAKE receiver finger is represented by element 201-1. Other RAKE receiver fingers are similar and are not described herein. As such, receiver 200 comprises a number of RAKE receiver fingers (as represented by elements 201-1 through 201-K), controller 225, combiner 235, control signal detector 295 and turbo/convolutional decoder 230. Element 201-1 further comprises demultiplexer 205, delay element 210, channel estimation element 215 and coherent demodulator 220. (See specification, pp. 7-8.)

Wireless signal 116 is received by demultiplexer 205. As noted above, wireless signal 116 represents the transmitted PSAM signal 111 as affected by fading, interference and noise (if any). Demultiplexer 205 demultiplexes the received wireless signal 116 to provide a data signal 206 (representing a

sequence of data symbols) and a control signal 207-1 (which comprises a sequence of pilot symbols and other information, such as the above-mentioned β). The data signal 206 is applied to delay element 210, which delays the data signal as known in the art to provide a sequence of data symbols 216, comprising inphase and quadrature components as represented by $\left(\underline{r}_I, \underline{r}_Q\right)$. Similarly, control signal 207-1 is applied to channel estimation element 215. The latter processes the control signal to provide an appropriate delay to the pilot portion of control signal 207 $\left(\underline{p}_I, \underline{p}_Q\right)$ (not shown), which are further processed by channel estimation element 215 through suitable filtering/averaging techniques to produce a sequence of channel estimates $\left(\underline{\hat{P}}_I, \underline{\hat{P}}_Q\right)$ represented by signal 217. In addition, channel estimation element 215 uses other control information to provide a signal(s) 218-1 representing values for G and σ_N^2 to controller 225. Control signal 207-1 (along with the control signals from the other fingers) is also applied to control signal detector 295, which combines all fingers to provide one value of β to controller 225, via signal 296. (Often, channel estimation element 215 and control signal detector 295 comprise a stored-program based processor for performing the above-mentioned computations.) In accordance with the invention, demodulation of the received signal is performed as a function of the scale factor as represented by equation (9). In particular, controller 225, in accordance with equation (9),

determines the scale factor, the value of which is provided to coherent demodulator 220 via signal 226-1. Coherent demodulator 220 provides the LLR $\left(\Lambda\left(\underline{r},\hat{\underline{p}}\right)\right)$ as a function of the scale factor (in accordance with equation (5)), via signal 221-1, for use by turbo/conventional decoder 230, which provides decoded information bit stream 231. Alternatively, equation (4) could be used, wherein channel estimation element 215 and control signal detector 295 use other control information to provide a signal(s) 218-1 and 296 representing values for β, $\underline{G}$ and $\underline{\sigma}_N^2$ to controller 225. As can be observed from FIG. 2, controller 225 provides a scale factor for use by each finger of the wireless receiver (as represented by signals 226-I and 226-K). The output signals of each finger (221-I through 221-K) are combined by combiner 235 for forming a combined $\Lambda\left(\underline{r},\hat{\underline{p}}\right)$ for use by turbo/convolutional decoder 230 (see specification, pp. 8-9).

When the scale factors are independent of the multipath index as embodied in equation (9), an alternative look-up table implementation may be used, where *a priori* values are determined (e.g., as described earlier) for σ_N^2, and G in order to determine w from equation (9) in advance. Such an illustrative look-up table is shown in FIG. 3 (Exhibit 3), which assumes that σ_N^2 and G are independent of the multipaths, i, as is usually the case. This look-up table has been constructed assuming that $\sigma_N^2 = 2$ and G = 0.01. The look-

up table *a priori* associates values of β with values for the associated scale factor. As can be observed from FIG. 3, the value of the square root of β is used as the index to the value of the scale factor.

A receiver 300 representing such an implementation is shown in FIG. 4 (Exhibit 4). This receiver is identical to the receiver shown in FIG. 2 other than the use of scale factor look-up table 250 and the combination of the channel estimation element with the control signal detector (as represented by element 290). For simplicity, elements relating to the other fingers (such as a combiner, etc., as shown if FIG. 2) are not shown. As such, only that portion of the receiver is described. Channel estimation and control symbol detector element 290 provides a value for β (or, alternatively, a value representing the square root of β), via signal 219, to scale factor look-up table 250. The latter calculates, if necessary, the value for the square root of β and retrieves the associated value for the scale factor from a memory array (not shown) which implements the look-up table. (Obviously, if calculating a square root, then either another look-up table is used for square root values and/or scale factor look-up table 250 also comprises a stored-program-controlled processor (not shown).) The value of the retrieved scale factor is provided, via signal 226, to coherent demodulator 220 for use in determining the LLR as described above (see specification, pp. 9-10),

Another embodiment of the inventive concept is shown in FIG. 5 (Exhibit 5). Receiver 400 is similar to receiver 200 of FIG. 2 except for signal detector 275, scale factor lookup table 280 and multiplier 285. In the embodiment of FIG. 5, control signal detector 275 combines the control signal portion from each finger of a RAKE receiver (as represented by 202-1 through 202-2, with respective control signal portions 207-I through 207-K) to provide a single value for β (or, alternatively, a value representing the square root of β), via signal 276, to scale factor look-up table 280. The latter calculates, if necessary, the value for the square root of β and retrieves the associated value for the scale factor from a memory array (not shown) which implements the look-up table. (Obviously, if calculating a square root, then either another look-up table is used for square root values and/or scale factor look-up table 280 also comprises a stored-program-controlled processor (not shown).) The value of the retrieved scale factor is provided, via signal 281, to multiplier 285, which multiplies the combined LLR provided by combiner 235 to provide a resultant LLR for use by turbo/convolutional decoder 230.

It should be observed that in either receiver approach described above, there is no need to compute or estimate the number and relative strengths of the multipaths, nor does the fading distribution need to be known. β is identical for all multipaths.

The foregoing merely illustrates the principles of the invention and it will thus be appreciated that those skilled in the art will be able to devise numerous alternative arrangements which, although not explicitly described herein, embody the principles of the invention and are within its spirit and scope. For example, although described in the context of optimum demodulation of PSAM signals, the inventive concept is applicable to other pilot signal based schemes (such as, but not limited to, the one used in the North America CDMA 2000 standard). Indeed, the inventive concept is not restricted to CDMA. Further, although shown as separate elements, any or all of the elements of FIGs. 1, 2, 4 and 5 (e.g., coherent demodulator 220) may be implemented in a stored-program-controlled processor (see specification, p. 10).

VI. <u>ISSUES PRESENTED</u>

i. Whether or not claims 1, 3-6, 9-11, 15-17, 21, 23, 24, 27, 28 and 30-33 are patentable under 35 U.S.C. §103(a) over Ling et al., U.S. Patent No. 6,377,607 ("Ling") in view of an article by Sampath and Kumar ("Article"), Jalloul et al., U.S. Patent No. 6,192,040 ("Jalloul") and Holtzman, U.S. Patent No. 6,393,257 ("Holtzman")?

VII. <u>GROUPING OF THE CLAIMS</u>

Appellant respectfully requests, for the purposes of this Appeal, that the grouping of the claims be as follows:

Group I: claims 1, 4, 6, 9-11, 16, 17, 20, 24, 28 and 30-33; and

Group II: claims 3, 5, 15, 21 and 27.

The claims of Group I stand and fall together. The claims of Group II stand and fall together.

VIII. ARGUMENTS

a) The Rejections

The following summary of the Examiner's rejections is based on the Final Rejection, dated January 23, 2004.

The Examiner has rejected claims 1-29 under 35 U.S.C. §103(a) as being obvious in view of the combination of Ling, the Article, Jalloul and Holtzman. For purposes of this Appeal, Appellants also presume the Examiner would have also rejected claims 30-33 based on the same rejections.

b) Reasons Supporting the Allowability of Group I Claims (Claims 1, 4, 6, 9-11, 16, 17, 20, 24, 28 and 30-33)

Preliminarily, Appellants note that they have submitted a §1.132 Declaration (see Appendix C) which effectively removes the Article as a prior art reference.

As presently written, each of the Group I claims are directed at an index of a look-up table, or look-up table values, used to retrieve a scale factor where the index or look-up table values are a function of a noise variance of received

pilot symbols ("first" noise variance) or a function of the first noise variance and a noise variance of received data symbols.

Neither Ling, taken separately or in combination with any of the remaining references (i.e., Jalloul and Holtzman) discloses or suggests the use of an index or look-up table values used to determine a scale factor based on the noise variance of pilot symbols or based on the noise variance of pilot symbols and the noise variance of data symbols, as in claims 1, 4, 6, 9-11, 16, 17, 20, 24, 28 and 30-33 of the present invention.

Instead, Ling discloses an attempt to scale an LLR by carrying out a complete estimation of signal-to-noise ratios along with other parameters. Said another way, claims 1, 4, 6, 9-11, 16, 17, 20, 24, 28 and 30-33 are based upon the realization by the present inventors that an LLR can be scaled using a far more ingenious method than that disclosed or suggested by Ling or any of the other remaining references; namely, by using the noise variance of pilot symbols only, or by using the noise variance of pilot symbols and the noise variance of data symbols. Because the present invention makes use of one or both noise variances, estimations required by the present invention are far simpler and easier to carry out than the estimations required by Ling. Ling's failure to realize that an LLR can be scaled using one or both of the above-mentioned noise variances is Ling's downfall.

Because simpler estimates may be made, one of the advantages provided by the present invention is that fewer errors occur as compared to Ling where it can be expected that a greater number of errors will occur because of the significantly higher number of estimates which Ling needs to complete to scale an LLR.

To the Examiner's credit, the Examiner appears to recognize this because in the Final Rejection the Examiner appears to indicate that Ling is silent on the use of the noise variance of received pilot symbols (see for example, page 4 of the Final Rejection). However, the Examiner has not yet responded to Appellants' Request which placed this feature into the independent claims of Group I.

In addition, the Group I claims are also patentable over Ling in combination with any of the remaining references because none of the remaining references overcomes the deficiencies of Ling, namely none discloses or suggests the use of a noise variance of pilot symbols or the use of a noise variance of pilot symbols and a noise variance of data symbols as an index or as a value to select a scale factor for a look-up table to scale an LLR, as in the claims of the present invention.

In more detail, Holtzman has nothing at all to do with the determination of a scaling factor for an LLR, as in the claims of the present invention.

Instead, Holtzman is aimed at a better way to estimate signal-to-noise ratios. It is respectfully submitted that the claims of the present invention would not have been obvious to one of ordinary skill in the art at the time the present application was filed upon reading the disclosures of Ling and Holtzman because neither disclosure comes close to disclosing or suggesting that an LLR can be scaled by using only the noise variance of pilot symbols or a noise variance of pilot symbols and a noise variance of data symbols, as in claims 1, 4, 6, 9-11, 16, 17, 20, 24, 28 and 30-33 of the present invention.

Accordingly, Appellants respectfully request that the Board reverse the rejection decisions contained in the Final Rejection and allow claims 1, 4, 6, 9-11, 16, 17, 20, 24, 28 and 30-33.

c) Reasons Supporting the Allowability of Group II Claims (Claims 3, 5, 15, 21 and 27)

Appellants respectfully assert that claims 3, 5, 15, 21 and 27 are patentable over Ling separately or in combination with any of the references for the reasons stated above with respect to the Group I claims.

In addition to the above rationales, claims 3, 5, 15, 21 and 27 are additionally patentable over Ling, taken separately or in combination with any of the remaining references, because neither Ling nor any of the remaining references discloses or suggests a scale factor which is determined

independently of the relative strengths and number of multipaths of a received wireless signal, as in claims 3, 5, 15, 21 and 27. Said another way, these claims provide for the estimation of the noise variance of pilot symbols for an entire wireless signal, instead of on a per-path or per-channel basis.

Instead, Ling discloses that its estimates must be carried out on a per-channel basis and cannot be carried out based on an estimate of an entire wireless signal. For example, Ling at page 10, lines 55-56, discloses the use of a "channel estimate SIR". As is known by those of ordinary skill in the art, channel estimates must be carried out on a per-path basis and cannot be carried out using an entire wireless signal. Contrary to the Ling citations contained in the Final Rejection, this citation in Ling is the most pertinent citation and clearly indicates that Ling's estimates must be carried out on a per-path or channel basis. The estimates cannot be carried out "independently of relative strengths and number of multipaths in the received wireless signal," as in claims 3, 5, 15, 21 and 27 of the present invention. Instead, the reference to Ling in the Final Rejection (i.e., column 4, lines 37-67) is merely a general equation of a log-likelihood ratio scaling factor.

Accordingly, Appellants respectfully request reversal of the rejection decisions contained in the Final Rejection and allowance of claims 3, 5, 15, 21 and 27.

IX. CONCLUSION

Accordingly, for at least the aforementioned reasons, Appellants respectfully request the Honorable Members of the Board of Patent Appeals and Interferences to reverse each of the outstanding rejections in connection with the present application and allow each of claims 1, 3-6, 9-11, 15-17, 21, 23, 24, 27, 28 and 30-33 to be allowed in connection with the present application.

This Appeal Brief is being presented in triplicate.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No.08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

HARNESS, DICKEY, & PIERCE, P.L.C.

By: ______________________________

John E. Curtin, Reg. No. 37,602
P.O. Box 8910
Reston, Virginia 20195
(703) 668-8000

JEC:psy

APPENDIX A

1. (Previously Presented) A wireless receiver comprising:

a receiver for receiving a wireless signal comprising pilot symbols and data symbols; and

a demodulator for generating a log-likelihood ratio as a function of a scale factor;

wherein the scale factor is stored in a look-up table such that an index into the look-up table used in retrieving the scale factor is a function of a noise variance of the received pilot symbols of the wireless signal.

2. (Cancelled)

3. (Previously Presented) The wireless receiver of claim 1 wherein the scale factor is determined independently of relative strengths and number of multipaths in the received wireless signal.

4. (Previously Presented) The wireless receiver of claim 1 further comprising a processor for determining the scale factor as a function of the noise variance of the received pilot symbols of the received wireless signal.

5. (Original) The wireless receiver of claim 4 wherein the scale factor is determined independently of relative strengths and number of multipaths in the received wireless signal.

6. (Previously Presented) The wireless receiver of claim 1 further comprising a memory for storing the look-up table.

7. – 8. (Cancelled)

9. (Previously Presented) The wireless receiver of claim 1 wherein the receiver comprises a demultiplexer for providing a data signal, representing the data symbols, and a control signal, representing the pilot symbols.

10. (Previously Presented) The wireless receiver of claim 9 wherein the receiver comprises a control signal detector for recovering from the control signal a value for a ratio between the energy per pilot symbol to the energy per data symbol.

11. (Previously Presented) A wireless receiver comprising:

a memory for storing a look-up table, such that an index into the look-up table for retrieving a scale factor associated with a log-likelihood ratio is a function of a noise variance of received pilot symbols of a wireless signal which comprises the pilot symbols and data symbols; and

a decoder, responsive to a signal modified by the retrieved scale factor, for decoding a received form of the wireless signal.

12. – 14. (Cancelled)

15. (Previously Presented) The wireless receiver of claim 11 wherein the scale factor is determined independently of relative strengths and number of multipaths in the received form of the wireless signal.

16. (Previously Presented) The wireless receiver of claim 11 further comprising a control signal detector for recovering from the received form of the wireless signal a value for a ratio between the energy per pilot symbol to the energy per data symbol.

17. (Previously Presented) A wireless receiver comprising:

a memory for storing a look-up table, wherein one column of the look-up table comprises values that are a function of a noise variance of received pilot symbols of a wireless signal which comprises the pilot symbols and data symbols, and a second column of the look-up table provides associated values of a scale factor; and

a demodulator, responsive to retrieved values of the scale factor, for demodulating a received form of the wireless signal and generating a log-likelihood ratio as a function of the scale factor.

18. – 20. (Cancelled)

21. (Previously Presented) The wireless receiver of claim 17 wherein the scale factor values of the look-up table are determined independently of relative strengths and number of multipaths in the received form of the wireless signal.

22. (Cancelled)

23. (Previously Presented) The wireless receiver of claim 20 further comprising a control signal detector for recovering from the received form of the wireless signal a value for a ratio between the energy per pilot symbol to the energy per data symbol for use by the memory.

24. (Previously Presented) A wireless receiver comprising:

a demodulator for demodulating a received wireless signal comprising pilot symbols and data symbols; and

a processor for determining a scale factor using a look-up table such that an index into the look up table is a function of a noise variance of the received pilot symbols of the wireless signal, and for providing the determined scale factor to the demodulator for use in demodulating a received form of the wireless signal; and wherein the demodulator generates a log-likelihood ratio as a function of the scale factor.

25. – 26. (Cancelled)

27. (Original) The wireless receiver of claim 24 wherein the scale factor is determined independently of relative strengths and number of multipaths in the received wireless signal.

28. (Previously Presented) The wireless receiver of claim 24 wherein the index is a function of a noise variance in the received data symbols of the received form of the wireless signal, and the noise variance in the received pilot symbols of the received form of the wireless signal.

29. (Cancelled)

30. (Previously Presented) The wireless receiver of claim 4 wherein the processor further determines the scale factor as a function of the noise variance of the received pilot symbols and a noise variance of the received data symbols of the received wireless signal.

31. (Previously Presented) The wireless receiver of claim 1 wherein the index into the look-up table used in retrieving the scale factor is a function of the noise variance of the received pilot symbols and a noise variance of the received data symbols of the received wireless signal.

32. (Previously Presented) The wireless receiver of claim 11 wherein the index for retrieving the scale factor is a function of the noise variance of the received pilot symbols and a noise variance of the received data symbols.

33. (Previously Presented) The wireless receiver of claim 17 wherein the one column of the look-up table further comprises values that are a function of the noise variance of the received pilot symbols and a noise variance of the received data symbols.

APPENDIX B PATENT

IN THE U.S. PATENT AND TRADEMARK OFFICE

Inventors:	Sarath KUMAR et al.		
Docket No.:	29250-001051/US		
Lucent Case No.:	Kumar 16-11-3-5		
Application No.:	09/651,849	Group Art Unit:	2683
Filing Date:	August 31, 2000	Examiner:	S. M. D'Agosta
Title:	ENHANCED METRIC FOR BIT DETECTION ON FADING CHANNELS WITH UNKNOWN STATISTICS		

REQUEST FOR RECONSIDERATION

Box AF
Honorable Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

June 23, 2004

Sir:

Applicants are in receipt of the Final Office Action dated January 23, 2004 ("Office Action"), the due date having been extended two (2) months to June 23, 2004, and respond as follows.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 9 of this paper.

AMENDMENT TO THE CLAIMS

Kindly delete claims 2, 7-8, 12-14, 18-20, 22, 25-26 and 29 without prejudice to, or disclaimer of, the subject matter disclosed therein. Much of the subject matter of the cancelled claims has been incorporated into the claims which remain.

Kindly amend claims 1, 3, 4, 9-11, 15-17, 21, 23, 24 and 28 and add new claims 30-33 as follows.

The following is a complete listing of revised claims with a status identifier in parenthesis.

LISTING OF CLAIMS

1. (Currently Amended) A wireless receiver comprising:

a receiver for receiving a wireless signal comprising pilot symbols and data symbols; and

a demodulator for generating a log-likelihood ratio as a function of a scale factor;

wherein the scale factor is stored in a look-up table such that an index into the look-up table used in retrieving the scale factor is a function of a ~~ratio between energy components~~ a noise variance of the received pilot symbols of the wireless signal.

2. (Cancelled)

3. (Currently Amended) The wireless receiver of ~~claim 2~~ claim 1 wherein the scale factor is determined independently of relative strengths and number of multipaths in the received wireless signal.

4. (Currently Amended) The wireless receiver of claim 1 further comprising a processor for determining the scale factor as a function of ~~the ratio between energy components of the wireless signal, a noise variance in received data symbols of the received wireless signal, and a~~ the noise variance [[in]] of the received pilot symbols of the received wireless signal.

5. (Original) The wireless receiver of claim 4 wherein the scale factor is determined independently of relative strengths and number of multipaths in the received wireless signal.

6. (Previously Presented) The wireless receiver of claim 1 further comprising a memory for storing the look-up table.

7. – 8. (Cancelled)

9. (Currently Amended) The wireless receiver of claim 1 wherein the receiver comprises a demultiplexer for providing a data signal, representing <u>the</u> data symbols, and a control signal, representing <u>the</u> pilot symbols~~, and wherein the ratio between energy components is a ratio between the energy per pilot symbol to the energy per data symbol~~.

10. (Currently Amended) The wireless receiver of claim 9 wherein the receiver comprises a control signal detector for recovering from the control signal a value for [[the]] <u>a</u> ratio between the energy per pilot symbol to the energy per data symbol.

11. (Currently Amended) A wireless receiver comprising:

a memory for storing a look-up table, such that an index into the look-up table for retrieving a scale factor <u>associated with a log-likelihood ratio</u> is a function of a ~~ratio of energy components~~ <u>noise variance of received pilot symbols</u> of a wireless signal <u>which comprises the pilot symbols and data symbols</u>; and

a decoder, responsive to a signal modified by the retrieved scale factor, for decoding a received form of the wireless signal.

12. – 14. (Cancelled)

15. (Currently Amended) The wireless receiver of claim 11 wherein the scale factor ~~values of the look-up table are~~ is determined independently of relative strengths and number of multipaths in the received form of the wireless signal.

16. (Currently Amended) The wireless receiver of claim 11 further comprising a control signal detector for recovering from the received form of the wireless signal a value for [[the]] a ratio between the energy per pilot symbol to the energy per data symbol.

17. (Currently Amended) A wireless receiver comprising:

a memory for storing a look-up table, wherein one column of the look-up table comprises values that are a function of a noise variance of received pilot symbols ~~ratio of energy component~~s of a wireless signal which comprises the pilot symbols and data symbols, and a second column of the look-up table provides associated values of a scale factor; and

a demodulator, responsive to retrieved values of the scale factor, for demodulating a received form of the wireless signal and generating a log-likelihood ratio as a function of the scale factor.

18. – 20. (Cancelled)

21. (Currently Amended) The wireless receiver of claim 17 wherein the scale factor values of the look-up table are determined independently of relative strengths and number of multipaths in the received form of the wireless signal.

22. (Cancelled)

23. (Currently Amended) The wireless receiver of ~~claim 17~~ claim 20 further comprising a control signal detector for recovering from the received form of the wireless signal a value for [[the]] a ratio between the energy per pilot symbol to the energy per data symbol for use by the memory.

24. (Currently Amended) A wireless receiver comprising:

a demodulator for demodulating a received wireless signal comprising pilot symbols and data symbols; and

a processor for determining a scale factor using a look-up table such that an index into the look up table is a function of a noise variance of the received pilot symbols ~~ratio of energy components~~ of [[a]] the wireless signal, and for providing the determined scale factor to the demodulator for use in demodulating a received form of the wireless signal[[.]]; and wherein the demodulator generates a log-likelihood ratio as a function of the scale factor.

25. – 26. (Cancelled)

27. (Original) The wireless receiver of claim 24 wherein the scale factor is determined independently of relative strengths and number of multipaths in the received wireless signal.

28. (Currently Amended) The wireless receiver of claim 24 wherein the ~~processor determines the scale factor as~~ index is a function of ~~the ratio between energy components of the wireless signal,~~ a noise variance in the received data symbols of the received form of the wireless signal, and [[a]] the noise variance in the received pilot symbols of the received form of the wireless signal.

30. (Cancelled)

30. (New) The wireless receiver of claim 4 wherein the processor further determines the scale factor as a function of the noise variance of the received pilot symbols and a noise variance of the received data symbols of the received wireless signal.

31. (New) The wireless receiver of claim 1 wherein the index into the look-up table used in retrieving the scale factor is a function of the noise

variance of the received pilot symbols and a noise variance of the received data symbols of the received wireless signal.

32. (New) The wireless receiver of claim 11 wherein the index for retrieving the scale factor is a function of the noise variance of the received pilot symbols and a noise variance of the received data symbols.

33. (New) The wireless receiver of claim 17 wherein the one column of the look-up table further comprises values that are a function of the noise variance of the received pilot symbols and a noise variance of the received data symbols.

REMARKS

Claims 1, 3, 4, 9-11, 15-17, 21, 23, 24 and 28 have been amended and claims 30-33 have been added to place the application in condition for allowance. No new subject matter has been added to these claims. Accordingly, Applicants submit that no additional search needs to be carried out by the Examiner in order to consider and enter the presently amended claims and new claims. Each of the new claims was derived from a previously included claim or claims.

Original claims 1-29 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ling et al., U.S. Patent No. 6,377,607 ("Ling") in view of Sampath and Kumar VTC Conference 9/1999 ("Sampath article"), Jalloul et al., U.S. Patent No. 6,192,040 ("Jalloul") and Holtzman, U.S. Patent No. 6,393,257 ("Holtzman").

Preliminarily, Applications note that they have submitted a §1.132 Declaration which effectively removes the Sampath article as a prior art reference.

As presently written, the claims of the present invention are directed at an index of a look-up table, or look-up table values, used to retrieve a scale factor where the index or look-up table values are a function of a noise

variance of received pilot symbols ("first" noise variance) or a function of the first noise variance and a noise variance of received data symbols.

Neither Ling, taken separately or in combination with any of the remaining references discloses or suggests the use of an index or look-up table values used to determine a scale factor based on the noise variance of pilot symbols or based on the noise variance of pilot symbols and the noise variance of data symbols, as in the claims of the present invention.

Instead, Ling discloses an attempt to scale a log-likelihood ratio by carrying out a complete estimation of signal-to-noise ratios along with other parameters. Said another way, the claims of the present invention are based upon the realization by the present inventors that a log-likelihood ratio can be scaled using a far more ingenious method than that disclosed or suggested by Ling or any other remaining reference; by using the noise variance of pilot symbols only, or by using the noise variance of the pilot symbols and the noise variance of data symbols. Because the present invention makes use of one or both noise variances, estimations required by the present invention are far simpler and easier to carry out than the estimations required by Ling. It is Ling's failure to realize that the log-likelihood ratio could be scaled using one or both of the above-mentioned noise variances that is Ling's downfall.

Because simpler estimates may be made, one of the advantages provided by the present invention is that fewer errors occur as compared to Ling where it can be expected that a greater number of errors will occur because of the significantly higher number of estimates which Ling needs to complete in order to scale a log-likelihood ratio.

To the Examiner's credit, the Examiner appears to recognize this because in the Office Action the Examiner appears to indicate that Ling is silent on the use of the noise variance of received pilot symbols (see for example, page 4 of the Office Action).

Having put this feature in the independent claims, the Applicants respectfully submit that all of the present claims are patentable over Ling.

In addition, the claims of the present invention are also patentable over Ling in combination with any of the other references because none of the remaining references overcomes the deficiencies of Ling, namely none discloses or suggests the use of a noise variance of pilot symbols or the use of a noise variance of pilot symbols and a noise variance of data symbols as an index or as a value to select a scale factor for a look-up table to scale a log-likelihood ratio, as in the claims of the present invention.

Such a combination does not render obvious the claims of the present invention and is improper for at least the following reasons. Holtzman has

nothing at all to do with the determination of a scaling factor for a log-likelihood ratio, as in the claims of the present invention. Instead, Holtzman is aimed at a better way to estimate signal-to-noise ratios. It is respectfully submitted that the claims of the present invention would not have been obvious to one of ordinary skill in the art at the time the present application was filed upon reading the disclosures of Ling and Holtzman because neither disclosure comes close to disclosing or suggesting that a log-likelihood ratio can be scaled by using only the noise variance of pilot symbols or a noise variance of pilot symbols and a noise variance of data symbols, as in the claims of the present invention.

A. Comments Regarding Claims 3, 5, 15, 21 and 27

In addition to the above rationales, claims 3, 5, 15 and 21 are additionally patentable over Ling, taken separately or in combination with any of the remaining references, because neither Ling nor any of the remaining references discloses or suggests a scale factor which is determined independently of the relative strengths and number of multipaths of a received wireless signal, as in claims 3, 5, 15, 21 and 27. Said another way, these claims provide for the estimation of the noise variance of the pilot symbols for an entire wireless signal, instead of on a per-path or per-channel basis.

In contrast, Ling discloses that its estimates must be carried out on a per-channel basis and cannot be carried out based on an estimate of the entire wireless signal. For example, Ling at page 10, lines 55-56, discloses the use of a "channel estimate SIR". As is known by those of ordinary skill in the art, channel estimates must be carried out on a per-path basis and cannot be carried out taking the entire wireless signal. Contrary to the Ling citations contained in the Office Action, this citation in Ling is the most pertinent citation and clearly indicates that Ling's estimates must be carried out on a per-path or channel basis. The estimates cannot be carried out "independently of relative strengths and number of multipaths in the received wireless signal," as in claims 3, 5, 15, 21 and 27 of the present invention. The reference to Ling in the Office Action (i.e., column 4, lines 37-67) is merely a general equation of a log-likelihood ratio scaling factor.

Accordingly, Applicants respectfully request entry of the amendments because these amendments place the claims in condition for allowance and do not require any additional search by the Examiner. Applicants respectfully submit that these claims are allowable over the references cited by the Examiner, and, therefore, request withdrawal of the pending rejections and allowance of claims 1, 3-6, 9-11, 15-17, 21, 23, 24, 27, 28 and 30-33.

Applicants respectfully submit that these claims are allowable over the references cited by the Examiner, and, therefore, request withdrawal of the pending rejections and allowance of claims 1, 3-6, 9-11, 15-17, 21, 23, 24, 27, 28 and 30-33.

In the event that any matters remain at issue in the application, the Examiner is invited to contact the undersigned at (703) 668-8000 in the Northern Virginia area, for the purpose of a telephonic interview.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

HARNESS, DICKEY & PIERCE, P.L.C.

By: ______________________________
John E. Curtin, Reg. No. 37,602

P.O. Box 8910
Reston, VA 20195
(703) 668-8000

APPENDIX C

DECLARATION UNDER 37 C.F.R. §1.132

APPENDIX C

PATENT
29250-001051/US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Sarath KUMAR et al. Conf. No.: 4424

Serial No.: 09/651,849 Group: 2141

Filed: August 31, 2000 Examiner: Stephen M. D'Agosta

For: ENHANCED METRIC FOR BIT DETECTION ON FADING CHANNELS WITH UNKNOWN STATISTICS

DECLARATION UNDER 37 C.F.R. §1.132

Box AF
Honorable Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
Washington, DC 20231

Sir:

I, Pantelis Monogioudis, declare:

1. I believe I am a joint inventor of all the originally filed claims of the above-identified patent application.

2. The above-identified patent application is currently assigned to Lucent Technologies Inc. ("Lucent") as recorded on 22 March 2001, REEL/FRAME: 011670/0528.

3. I am currently an employee of Lucent.

4. Two of my joint inventors Sarath Kumar and Ashwin Sampath are the authors of a paper entitled "Analysis of Pilot Symbol Assisted Modulation (PSAM) Systems with Power Control and Diversity" ("article").

5. On information and belief, the article was submitted to a technical conference for publishing in Amsterdam, Netherlands, between September 19th and 22nd, 1999.

6. The article describes the work of my co-inventors Messrs. Kumar and Sampath, appears to include features of inventions that are claimed in the above-identified patent application, and was authorized for publication by Lucent.

7. At the time the article was published and at the time the above-identified patent application was filed, Messrs. Kumar, Sampath and myself were all employees of Lucent.

8. At the present time, Messrs. Kumar and Sampath are no longer employees of Lucent.

9. I have spoken to Mr. Kumar to verify the statements made in paragraphs 3-8 above.

10. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Pantelis Monogioudis

6/23/04
Date

FIG. 1

Prior Art

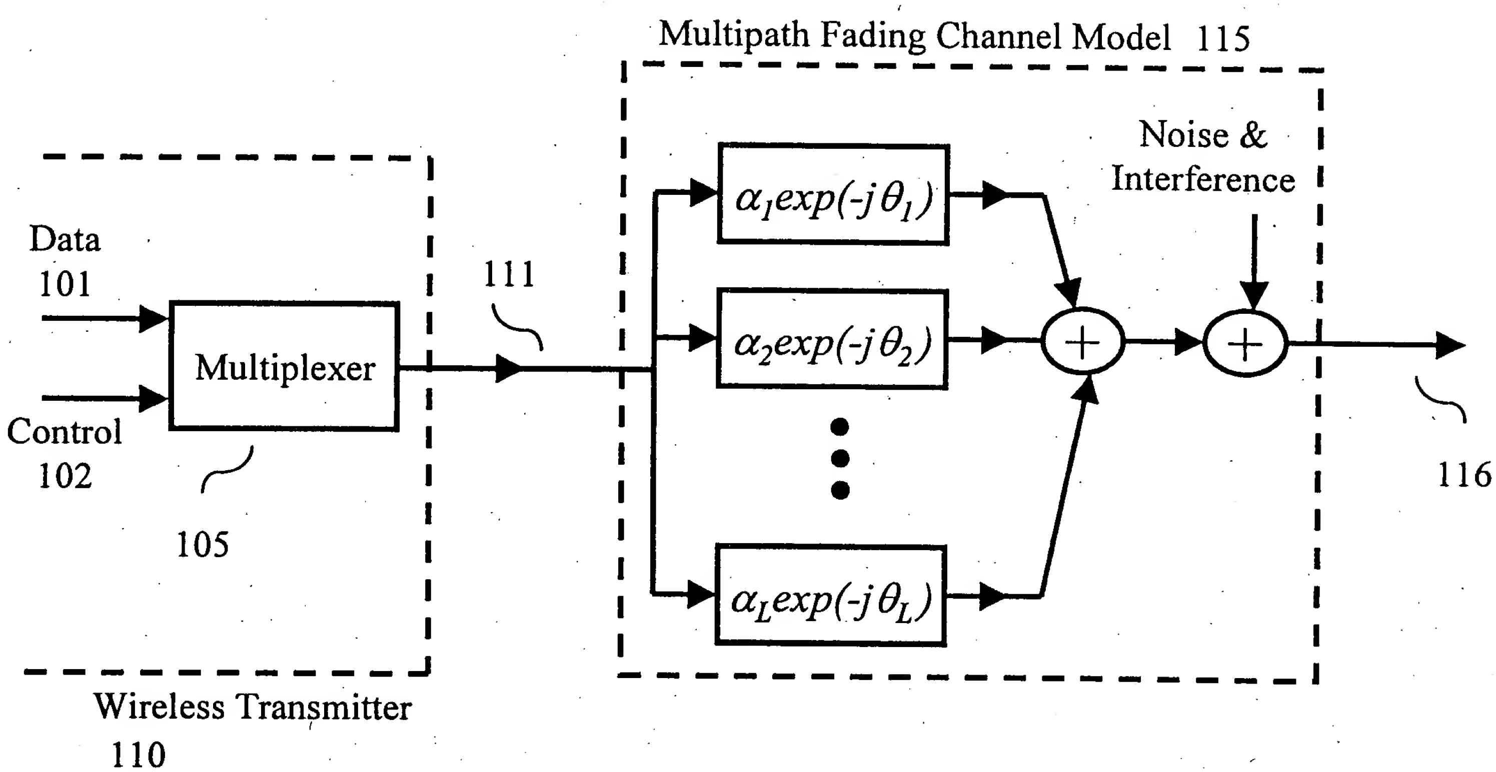

EXHIBIT 1

FIG. 2

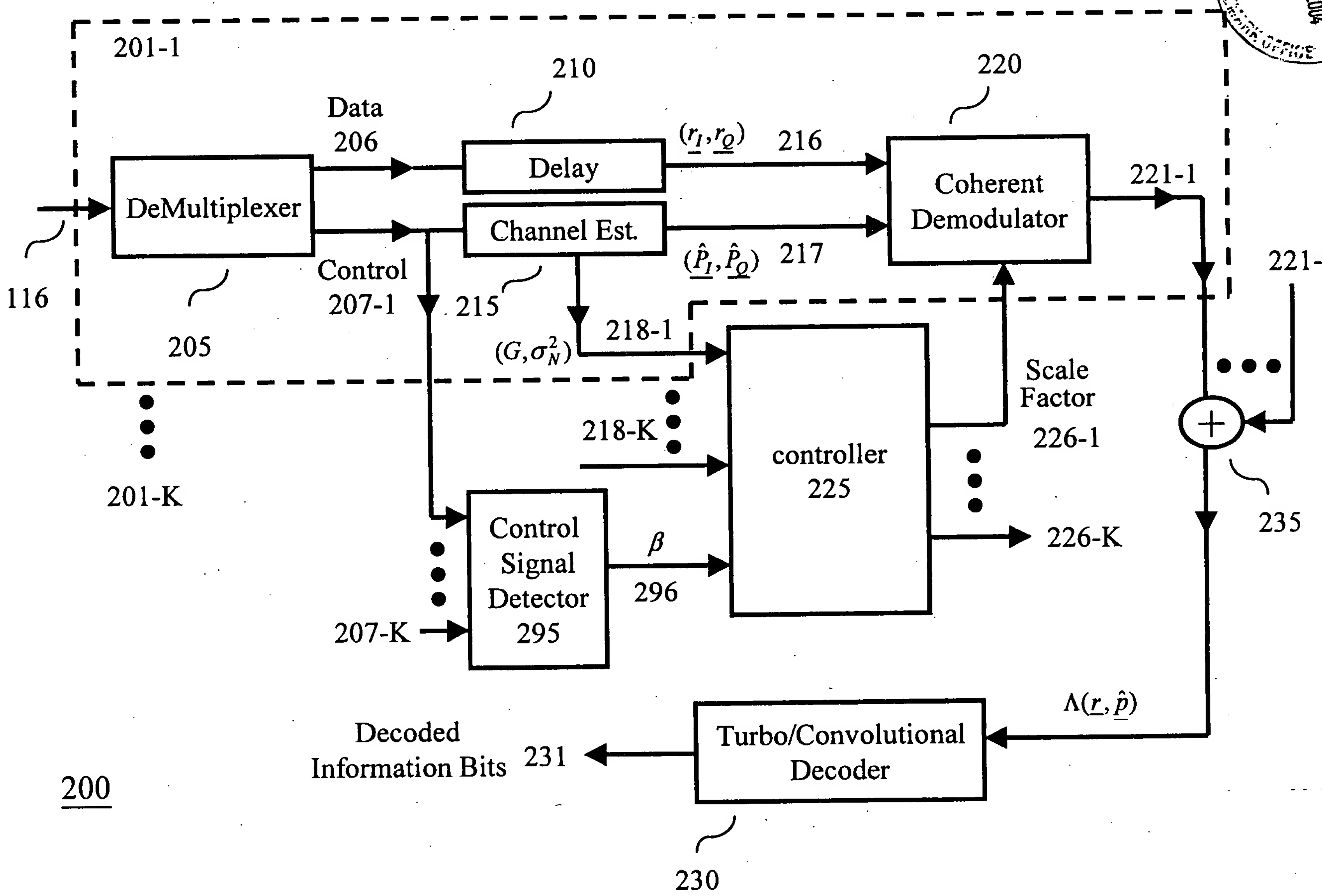

EXHIBIT 2

EXHIBIT 3

FIG. 3

$\sqrt{\beta}$	Scale Factor
0.066667	2.242991
0.133333	2.364532
0.2	1.983471
0.266667	1.635434
0.333333	1.371429
0.4	1.173594
0.466667	1.02252
0.533333	0.904381
0.6	0.809899
0.666667	0.732824
0.733333	0.668862
0.8	0.61499
0.866667	0.569032
0.933333	0.529384
1	0.494845

Scale Factor Look-up Table

FIG. 4

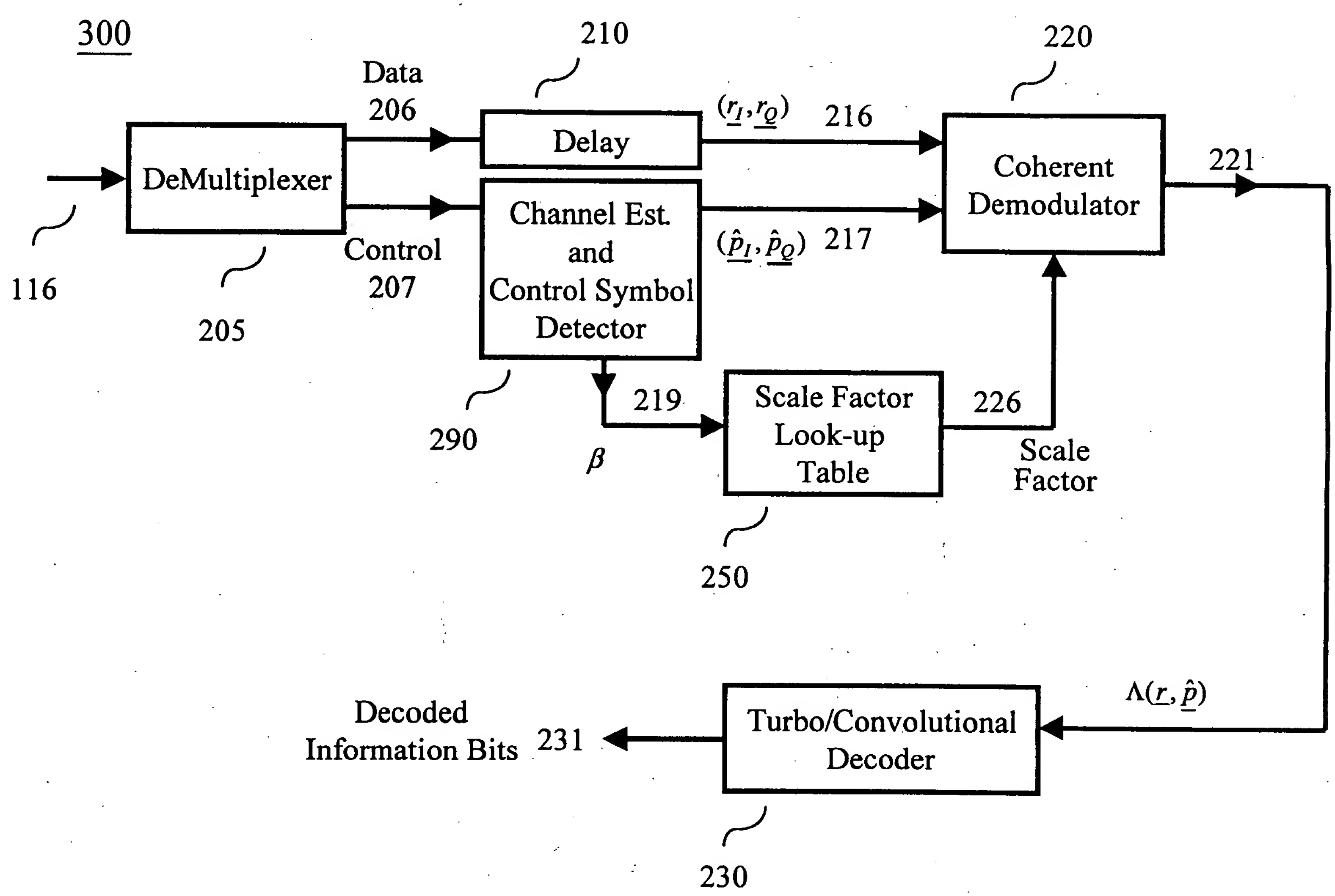

EXHIBIT 4

FIG. 5

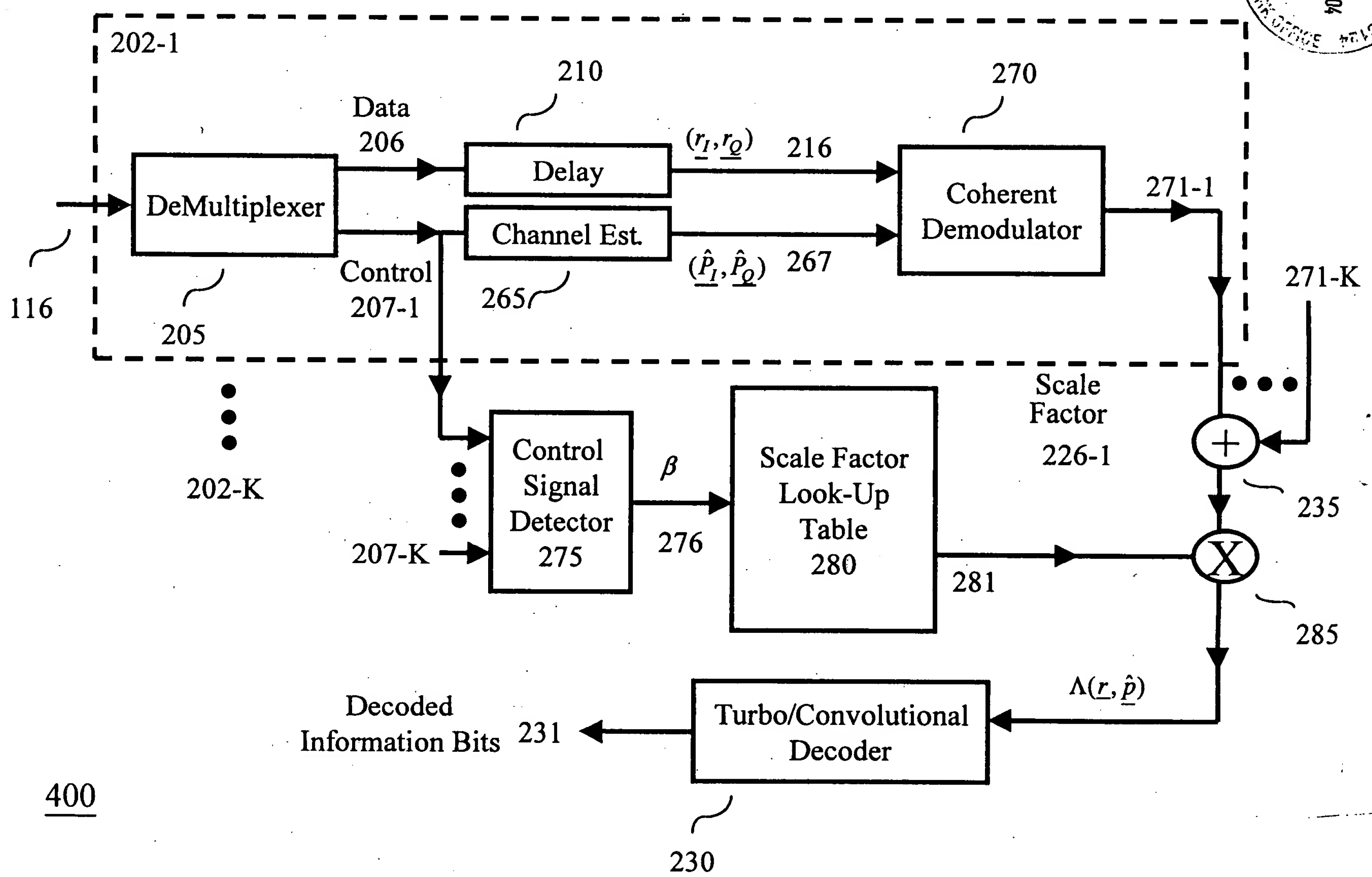

EXHIBIT 5